Spider mite predator tested for pesticide resistance on pears

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Under field conditions the spider mite predator M. occidentalis can resist low application rates of organophosphate pesticides; but the spider mite is 40 times more resistant to permethrin than its predator.

Spider mites have become increasingly important agricultural pests during the past 25 years. Major reasons for this increase in importance appear to be the ability of spider mites to tolerate or develop resistance to pesticides applied for their control and the destruction of their predators by pesticides. Thus, determining the effects of pesticides on predators of spider mites is an important component in developing pest management programs. Selective use or reduced rates of pesticide applications may allow spider mite predators to survive to control spider mites and still give effective control of the target insect pest.

California pear orchards were surveyed in 1977 for the phytoseiid predator, *Metaseiulus* (= *Typhlodromus*) *occidentalis* (Nesbitt). In Washington state, organophosphate pesticide resistance in *M. occidentalis* is a central component of an apple pest management program. This survey was conducted to determine the relative frequency and level of organophosphate-resistance in *M. occidentalis* from California pear orchards.

Orchards were searched during July and August 1977 for *M. occidentalis* in Lake, Mendocino, Napa, Solano, Sutter, and Yuba counties. Two additional colonies were collected and provided by Helmut Riedl from Sacramento County. Colonies were initiated using 20 to 30 females and were fed twospotted spider mites, *Tetranychus urticae* (Koch). When the colony contained at least 600 adult females, gravid females were mounted on their backs, 20 per slide, on double-sided sticky tape attached to glass microscope slides. The slides were dipped for 5 seconds into different concentrations of pesticides and held at 25° C for 48 hours at 70 percent relative humidity. The number of live females was then determined by whether the mites' appendages moved when touched by a fine brush. An LC_{50} (the concentration of pesticide that will kill 50 percent of the predators under the test conditions) was determined for each colony using logit analysis based on at least four concentrations of pesticides and five replicates per concentration. Control slides were dipped in water, held, and scored as above. Insecticides tested were 50 percent wettable powder formulations of diazinon and Guthion (asinphosmethyl), using 600 females per pesticide.

All colonies tested showed resistance to Guthion and to diazinon (see table). The LC_{50} values ranged from 0.8 to 4.3 pounds active ingredient (AI) per 100 gallons of Guthion. Since Guthion is commonly applied as a 50 percent wettable powder formulation, this implies that 50 percent of the predators could survive 1.6 to 8.6 pounds of Guthion 50W/100 gallons of water.

Similarly, for diazinon resistance varied, as indicated by LC_{50} values of 3.8 to 10.4 pounds AI/100 gallons. Diazinon has not commonly been applied to pears in recent years, so the high level of diazinon resistance observed was surprising. It is possible that resistance to Guthion imparts cross-resistance to diazinon since both pesticides are organophosphate compounds; alternatively, resistance to diazinon may have persisted despite the cessation of its usage.

Direct contact exposure of a pesticide to the adult stage of the target organism, which was evaluated in these laboratory tests, provides only an indication of how the pesticide effects populations under field conditions because other factors such as temperature, persistence, and deposit characteristics may influence the results. Generally, immature stages are more susceptible than the adults. However, these data suggest that low dosages of Guthion or diazinon will not be harmful to *M. occidentalis* under field conditions, and may explain the success of the California integrated pear pest management program in reducing spider mite problems. Low application rates of Guthion are recommended for codling moth, *Laspeyresia pomonella* (L.), control and are correlated with a lack of spider mite outbreaks.

A similar laboratory test was conducted with three colonies of *M. occidentalis* and with two colonies of *T. urticae*, using the synthetic pyrethroid permethrin. (The results are in fig.). The area contained within the dashed lines, from approximately 0.01 to 0.1 pound AI/100 gallons, is the range of currentlyrecommended field application rates. The two lines on the right give the responses of two colonies of *T. urticae.* These lines lie nearly completely outside the rates contained within the dashed lines, which means that the spider mite is nearly unaffected by recommended application rates of permethrin. In contrast, the three colonies of predator have LC_{50} values near the lower end of the recommended application rates. Therefore, permethrin is approximately 40 times more toxic to the predator than to the spider mite under laboratory conditions. Again, extension of laboratory data into the field situation needs to be done carefully, but the general conclusions are supported by the results of field trials with permethrin in which spider mite buildups have been observed frequently. The spider mite buildups may be due to predator mortality, or, perhaps, to physiological stimulation of spider mite reproduction, or both. Use of a synthetic pyrethroid for control of the pear psylla, *Psylla pyricola* Foerster, will provide a difficult problem for the pear pest manager since spider mites may become more serious.

A genetic selection program is in progress using these colonies to obtain a strain of *M. occidentalis* that is resistant to the synthetic pyrethroids as well as to organophosphate insecticides. If such a strain can be selected, its release and establishment in pear orchards might allow the use of synthetic pyrethroids without concomitant spider mite outbreaks.

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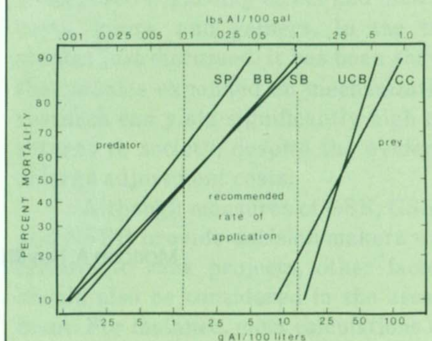
LC_{50}s of *Metaseiulus occidentalis* Collected from California Pear Orchards, 1977

Predator Source		LC_{50}* (95% confidence interval)	
County	Orchard	Guthion	Diazinon
El Dorado	Marchini	1.7 (1.1 - 2.4)	10.4 (6.7 - 16.2)
Lake	Ivicvich	1.6 (1.2 - 2.2)	3.8 (2.7 - 5.3)
	Jones, Home	3.7 (2.3 - 5.8)	5.9 (2.6 - 6.0)
Sacramento	Randall Island	1.8 (1.4 - 2.4)	5.0 (3.8 - 6.7)
	Sacramento River	4.3 (3.0 - 6.2)	-
Solano	Ames & Allbright	1.8 (1.5 - 2.3)	6.4 (4.8 - 8.6)
	Neitzel	0.8 (0.2 - 3.0)	3.0 (1.7 - 5.3)
Yuba	Campbell	2.0 (1.7 - 2.5)	8.6 (6.5 - 11.6)
	Di Giorgio, New England	1.1 (0.7 - 1.7)	10.1 (6.7 - 15.2)
	Levake	3.6 (2.7 - 5.0)	8.2 (5.5 - 12.5)

*Expressed as lbs A.I./100 gallons



The relative toxicity of permethrin to three predator colonies, *Metaseiulus occidentalis,* and to two colonies of the twospotted spider mite, *Tetranychus urticae.*

Tomato pomace scores well as sheep feed

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In 1977, approximately 5.5 million tons of California tomatoes were processed to make tomato paste and similar products. The skins and seeds, plus a small quantity of clinging pulp, collectively referred to as pomace, amounted to roughly 500,000 tons of material containing about 100,000 tons of dry matter. The study reported here was conducted to determine the feed value of this material.

The study consisted of two trials in which sheep were fed tomato pomace alone or mixed with alfalfa. In the first trial, fresh pomace was mixed with varying proportions of alfalfa hay to form rations of 0, 26, 48 and 77.5 percent pomace on a dry-matter basis. As a guide for mixing, a dry-matter sample was taken from each batch of pomace as it was received. Daily dry-matter samples of pomace were also taken at mixing time to permit accurate calculation of the resulting diets. All dried samples were composited and retained for use in the second trial in which sheep were fed a preweighed allowance of dried pomace only. Feces and urine for analyses were collected in each trial.

The pomace used was the byproduct from commercial processing of tomatoes for tomato paste. It was received in batches at approximately weekly intervals and stored under refrigeration until used. At first the sheep were hesitant to eat the pomace, but after a few days they consumed it quickly.

Table 1 shows the chemical composition of the alfalfa-tomato pomace diets. The crude protein level of all diets was approximately 20 percent. The crude fat (ether extract) and gross energy content increased proportionately as the level of